Decision making in regulatory entomology: the case of *Trogoderma variabile* in Western Australia

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Abstract

Western Australia is separated from the eastern states of Australia by 1000 km of desert and can often remain free of pests that occur in those states. When new pests are detected the general policy is one of eradication.

The warehouse beetle was first discovered in Western Australia on a farm in 1979 and eradication was attempted. The farm was found to be reinfested in 1991 and a second eradication program was carried out using sheet fumigation of all buildings and structures. The discovery soon after of another infestation 150 km away, resulted in the eradication policy being changed to one of containment while cost-benefit analyses, and state-wide survey using over 500 pheromone traps, were undertaken. The cost-benefit analysis calculated a positive ratio of nearly 13:1 over 30 years.

The uncertainty of success of an eradication attempt combined with the high probability of re-infestation, led government and industry representatives to decide against eradication.

Introduction

The warehouse beetle, *Trogoderma variabile* Ballion (Coleoptera: Dermestidae), was until recently a quarantine status pest in Western Australia (W.A.) and was subject to eradication whenever detected. In W.A., the control and regulation of stored product pests is managed by the Agriculture Protection Board of Western Australia (APB), which administers the *Agriculture and Related Resources Protection Act*. The APB is an industry board charged with the responsibility for providing agriculture protection on a State-wide basis. The Board comprises of representatives from producer organisations, local councils and representatives from Zone Control Authorities. The Board looks to Zone Control Authorities for recommendations on matters of local concern, which in turn, receive advice from Regional Advisory Committees. This structure provides decentralised community involvement in policymaking, while still allowing for a State authority to coordinate the effort.

The APB's staff is predominantly based in the country regions of the State. District officers inspect grain-producing properties routinely to ensure stored grain insect numbers are reduced to protect the grain export industry. An average of 30% of the grain-producing properties in the State are inspected each year.

The Western Australian Grain Protection Committee, which consists of grower, bulk handling, marketing, manufacturer and government representatives, advises the APB on policy and strategy matters relating to stored-product pests and control.

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History

The warehouse beetle was first found in Australia at Griffith, NSW in 1977 (Hartley and Greening 1983) and, when detected in W.A. in 1979, eradication was still being attempted. The eradication policy remained current in W.A. even after the attempt was abandoned in the eastern states in 1981. This was due to there being no other known infestations in this area of the country.

When the only known property to be infested in W.A. was found to be reinfested in 1991, a second eradication program was undertaken using sheet fumigation with methyl bromide and phosphine. All structures on the farm, including sheds, silos and house were fumigated and a survey was undertaken on all properties within 30 km. This program cost approximately $50000, and no further insects have since been detected at the property. Figure 1 shows the effort required to ensure successful eradication of warehouse beetle on farm.

In late 1991 another grain-producing property at Pithara, some 150 km away, was found to be infested. The Board decided to contain the infestation using residual insecticides in buildings and fumigants in grain storages to reduce total insect numbers. The objective was to reduce the potential for the infestation to spread while a limited detection program was undertaken using pheromone-baited flight traps throughout the State.

Detection Trapping Program

From the spring of 1991 until autumn 1992 pheromone traps were sited at likely locations throughout the wheat-growing areas of W.A. and in the Perth metropolitan area. Pheromone traps were used to detect the presence of warehouse beetle because of their effectiveness and efficiency (Wright 1993). Some 245 traps were serviced during this period. A major infestation was found centred on Carnamah, a small town in the northern wheat-growing area of the State, where insects were detected in 20 houses and commercial premises and 23 farm houses.

Trapping also indicated low-level infestations at Coorow, Wongan Hills, Dalwallinu and Perth.

Because the full distribution and extent of warehouse beetle was yet to be determined, the Grain Protection Committee decided upon a containment rather than an eradication policy. The expense of embarking on an eradication policy prematurely, the technical difficulty of the project and the uncertainty of success were also factors considered. The Grain Protection Committee agreed to review the containment decision at a meeting in April 1993 when the results of more extensive detection trapping program would be available.

During 1992-93, trap numbers were increased to 641, with all suspicious insects collected by field staff and forwarded for identification to the Entomology Laboratory of the Depart-

ment of Agriculture, Western Australia. The traps were routinely serviced by officers of the APB throughout the grain-growing areas and the State capital metropolitan area. Traps were placed at seed cleaning works, local feed or produce stores, private grain dealers, feed compactors, grocery stores, country grain receival points and farms with a history of poor hygiene. Trapping was also conducted by Co-operative Bulk Handling (CBH) at selected grain receival points throughout the wheat-growing areas of the State. These traps were serviced by CBH staff (Fig. 2) and insects sent to the Stored Grain Research Laboratory, CSIRO Canberra, for identification.

The 1992–93 trapping program indicated an even wider distribution of the pest, with insects having been caught at Three Springs, Williams, Goomalling, Northam, Wickepin, Clackline and Kellerberrin. Figure 3 shows the distribution of infestations. Most of the infestations detected indicated low insect numbers, as even when trap numbers were increased in an area to over 10 times more than when insects were first detected, in some cases no further insects were trapped. The level of insects detected was considerably lower than the area of infestation and number of insects caught per trap in central New South Wales during the same period.

Pheromone traps were used to trace the source of infestation in some towns. This was effective at Carnamah and Three Springs where the source was found and treated. However, in some towns, the numbers of insects trapped were too low to be of use in detecting infestation sources.

Decision-Making Process

The detection trapping program was crucial to the decision-making process, in that it was imperative to know the distribu-

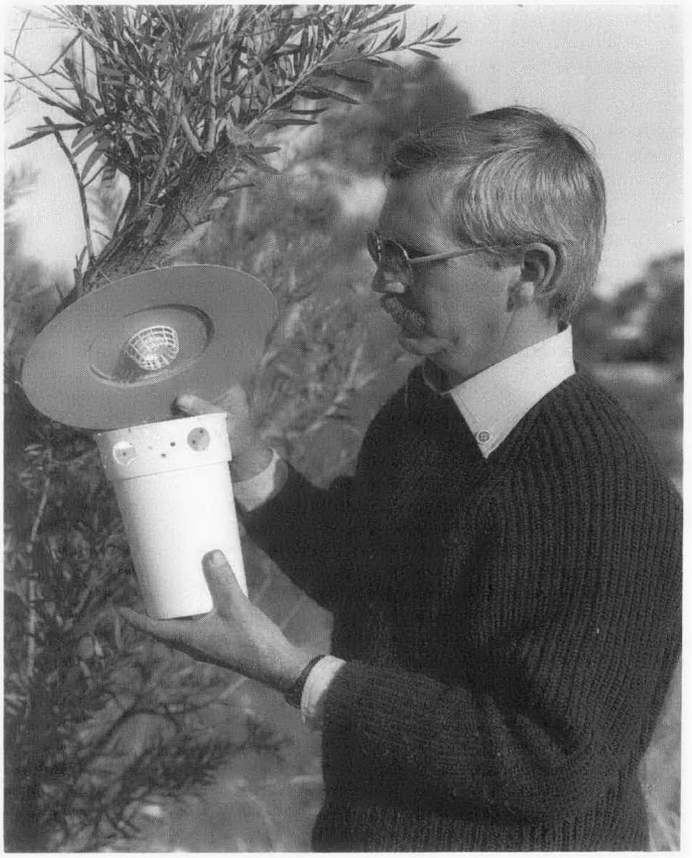

Fig. 2 Traps were routinely serviced by officers based in the field.

Fig. 1. Fumigation of the farm at Morawa appears to have been successful in eradicating warehouse beetle.

tion and extent of infestations throughout the State before making any decision on the feasibility of control or eradication of warehouse beetle. The use of pheromone traps was considered to be more cost effective and reliable than inspections of suspect premises.

The Grain Protection Committee was to make a final strategy decision at a meeting scheduled for April 1993. Options for the eradication, control, containment or otherwise were to be discussed at this meeting. Information on the costs associated with the eradication of warehouse beetle, versus control or containment, were prepared (K. Dean, unpublished data, 1993). The cases for and against eradication were discussed and are summarised below.

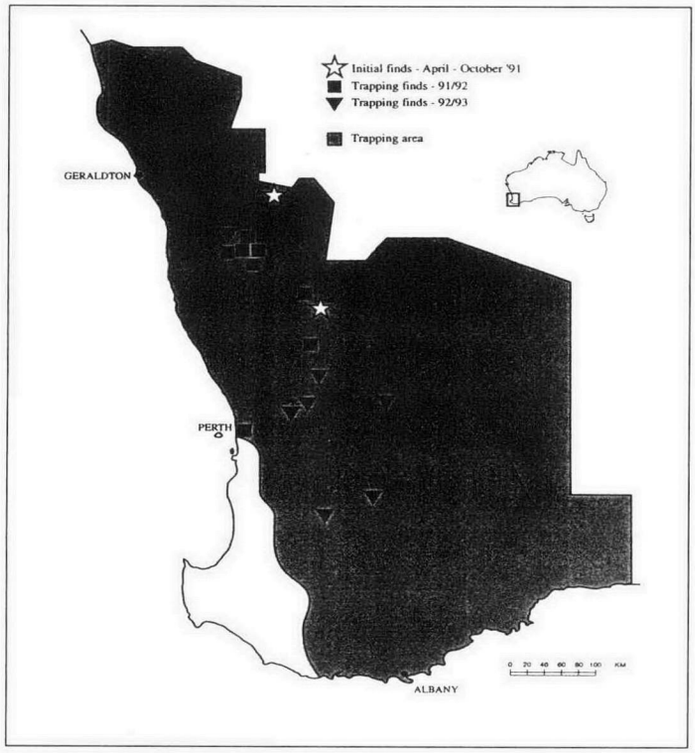

Fig. 3. Trap sites and distribution of warehouse beetle from the 1991–93 detection trapping.

The case for eradication

Economic

A cost-benefit analysis prepared by P. Coyle and N. Thomson (unpublished data, 1993) of the Department of Agriculture, Western Australia, Marketing and Economics Branch indicated that an eradication campaign would cost $2000000 in the first year, $640000 in the second year and approximately $250000 for every subsequent year. The total cost of an eradication campaign over 30 years was estimated at $12 080000 which, when discounted, was equivalent to $6419491. The costs associated with having warehouse beetle were estimated based on a limited survey conducted in the infested area and discussions with persons involved with the pest. Calculations were made over 30 years with on-costs of 25% and a discount rate of 7%. If an eradication program were undertaken, it was assumed that there would be a 70% chance that it would be successful and correspondingly, a 30% chance that the insect would infest all properties. The 30% chance was transferred into a weighted outcome to give an estimated number of infestations and a cost associated with those infestations.

The results of the calculations indicated a net present value of $76000000, with a benefit-cost ratio of 12.83 over 30 years.

Trade

Warehouse beetle has the potential to be mistaken for the Khapra beetle, *Trogoderma granarium* Everts, which is not known to exist in Australia. Should the identification of the insect be mistaken, the export grain industry to some countries may be jeopardised. Just as significantly, the widespread distribution of *T. variabile* would make it much more difficult to detect an introduction of *T. granarium* (Wright 1993). The incorrect classification of Australia as a 'Khapra country' in the 1950s took considerable effort to rectify (Bailey 1958).

Although *T. variabile* can attack almost any dried product of plant or animal origin, it is not a serious pest of bulk grains. The larvae can penetrate most common packaging materials (Cline 1978) and commonly infest packaged foods of all kinds. As such, it is expected to have some impact on grocery commodities, as has been demonstrated already in W.A. Wholesalers and retailers in the grocery, food packaging and food manufacturing industry could expect a level of infestation and some damage. The seed industry would be expected to find a higher level of insect infestation than currently occurs and serious damage to soft seeds would result.

Health

Insects were found in a wide range of food-stuffs and other products in grocery stores and homes during 1992. These included flour, bread crumbs, icing sugar, salt, spices, cocoa, baby cereals, oat bran, powdered soup, cat and dog food, noodles, pasta, crushed coconut, dried beans, peanuts, powdered milk, potato crisps, rice, wheat, biscuits, cake mixes, yeast, gelatine, and breakfast cereals.

Trogoderma species can pose health problems to humans, can cause diarrhoea in infants, and are highly allergenic (Okumura 1967). As *T. variabile* could be expected to spread throughout the southern part of the State within 20 years if eradication is not instigated or successful, there may be additional health risks associated with this increase in distribution. As there is little hope of householders eradicating the insect from their homes, there will be additional costs associated with food storage, spoilage and pest control.

Fig. 4. *T. variabile* larva were found in a variety of foods at Carnamah.

The case against eradication

The costs for eradication of *T. variabile* using methyl bromide fumigation was estimated at $40000 for each farm and $3000 for each town building. Costs of this magnitude are

clearly beyond the resources of individual landholders and additional funds would have to be sourced from government or industry.

Opinion on the likely success was divided, particularly in urban areas. Infestations on isolated farms may be eradicated, as demonstrated at Morawa in 1991, but to achieve complete success, every building would require fumigation. The possibility that *T. variabile* exists outside buildings in the infested areas and would reinfest fumigated buildings is a real threat to the success of the eradication program.

Locating the source of infestation has been unsuccessful in Perth, Wongan Hills, Dalwallinu, Goomalling, Williams, Northam, Coorow and Kellerberrin, although limited effort has been made to do so. The ability to locate all infestations becomes an important factor should an eradication program be attempted. If some survivors are detected after treatment, and the source cannot be located quickly, then reinfestation is highly likely. Further work on the detection of low-level infestations using pheromone traps is suggested.

Fumigation treatments would need to be applied in winter to minimise reinfestation by flying adults during summer months. Low temperatures, rain and high winds are not conductive to successful fumigation and would have presented safety difficulties.

T. variabile is now present in all mainland States of Australia with widespread infestations reported from inland New South Wales (Greening 1990). It is unlikely that any eradication effort will be initiated in other States, which will increase the probability of further incursions into W.A. The nature of the pest means that barrier quarantine measures cannot be relied upon to be 100% effective.

Carnamah has a population of around 600 people, and about 200 buildings. Should an eradication campaign have been initiated it would be necessary to evacuate all or at least large sections of the town to allow safe fumigation of all town site structures. The probability of damage, both physical and pesticide-induced, associated with such a large-scale operation would not improve community relations and may have resulted in litigation. This had to be weighed against the economic importance of the pest to the State.

Containment Program Recommended

At its last meeting (April 1993), the Grain Protection Committee discussed the findings of the State-wide pheromone trapping results and reviewed the pest potential of, and control options for, the species.

The results of the trapping survey indicated that the species was established in Western Australia, although the distribution was limited. Due to the difficulties of undertaking eradication, as well as the potential for further infestations to occur in the State, the Grain Protection Committee decided to adopt a containment and monitoring program. The containment strategy would consist of continuing inspections of known infestations and ensuring controls were undertaken to reduce insect numbers and limit the potential for spread. Routine inspections of all grain producers and merchants would continue, with increased emphasis on checking likely *Trogoderma* habitats. This would ensure the protection of export produce by maintaining a 'clean pipeline'.

The environmental health officers employed by local government authorities are to be trained in aspects of biology, inspection procedures and control of *T. variabile* to ensure advice can be distributed to householders and that public health is not compromised through infestation of food products in stores.

The monitoring strategy would continue throughout the State so that the effectiveness of the containment program could be assessed and new infestations detected. The community is to be informed of the distribution and extent of infestations. The committee would review these strategies at yearly intervals and advise the Board of the results of its findings, and make recommendations for future action.

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